

WELL MONITORING

IntelliSat™ pulsed neutron logging service

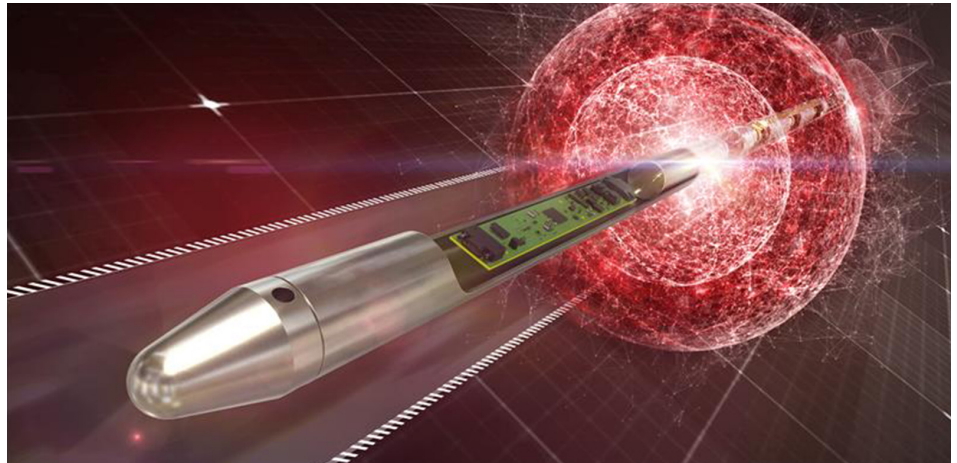
Thru-tubing pulsed neutron spectroscopy

FEATURES

- 21 characterized high resolution elemental yields plus KUTh
- Extensive borehole correction library, 4-16 in.
- Combinable with all Intelli-portfolio services
- E-line, RELAY™ digital slickline system, and memory conveyance

BENEFITS

- Mineralogy with total organic content thru-tubing
- Acquires spectral natural gamma elements (KUTh) for clay typing and scale ID
- Rig and rigless acquisition in any borehole fluid



Overview

The Halliburton IntelliSat™ pulsed neutron logging (PNL) service provides comprehensive thru-tubing formation evaluation. Whether an operator needs to monitor for saturation changes through a time-lapse acquisition program or obtain a primary dataset for complete petrophysical evaluation, the IntelliSat PNL service provides information to increase production and maximize recovery.

IntelliSat PNL service benefits from a comprehensive nuclear tool characterization. The expansive nuclear model reduces uncertainty in a wide range of borehole conditions with a vast corrections library to help facilitate answer products are more accurate, precise, and repeatable. The porosity ratio algorithm (PRAT) employs this characterization to deliver a measurement sensitivity that has more than doubled, with improved consistency in mixed salinity environments.

Advances in detector technology facilitate improved spectral resolution, and a new high-output neutron generator yields 85% more neutrons. Coupled with high-speed digital electronics, the IntelliSat PNL service can measure up to 21 individual elemental yields. These yields are fed into Halliburton's intuitive processing software studio where mineralogy is an integral answer product. Quick and consistent results are delivered with a level of certainty only attainable in an openhole environment in the past.

Halliburton provides the industry's only thru-tubing PNL tools capable to acquire natural spectral gamma ray, including potassium, uranium, and thorium (KUTh). In addition to clarity of the quality of conventional reservoir rock, this feature enables detailed clay-typing that completes the picture for geochemical analysis in unconventional reservoirs.



Additional IntelliSat™ PNL service applications:

- Three-phase holdup in vertical and horizontal wellbores
- Water flow behind casing
- Gravel-pack evaluation in conventional proppant, as well as proppant traced with radioactive and/or nonradioactive tracers, such as gadolinium

Traditional sigma and C/O saturation measurements are complemented with a new, fully characterized gas saturation using count ratios from the long-spaced detector. The measurement algorithm provides accurate gas saturation in low porosities

and in low or uncertain salinity environments. This ratio-based measurement is acquired at a logging speed of 30 ft/min to reduce intervention time. CO₂ saturations for carbon capture and underground storage (CCUS) projects are a natural application.

Extensive measurement capability is only beneficial where deployment is achievable. The IntelliSat PNL service is packaged in a 1-11/16-in. tool body and is capable to execute extended logging programs at up to 350°F without a flask and deployable on conventional e-line, slickline, RELAY™ digital slickline system, and coiled tubing provide operators with the most deployment options

Tool specifications

DESCRIPTION	DATA
Dimensions and ratings	
Maximum OD	1.69 in. (4.29 cm)
Maximum pressure*	15,000 psi (1,034 Bar)
Maximum temperature*	350°F (177°C)
Minimum restriction	1.81 in. (4.60 cm)
Maximum borehole OD	16.0 in. (40.6 cm)
Borehole conditions	
Borehole type	Open and cased
Borehole profile	Vertical, deviated, and horizontal
Borehole fluid	Water, oil, and gas
Flowing conditions	Static and dynamic
Recommended logging speed (spectral)	2 ft/min (61 cm/min), single pass
Recommended logging speed (time decay)	30 ft/min (9 m/min)
Hardware characteristics	
Spectral high resolution gamma scintillators	Near and far CeBr3 long GYSO
Spectral fast neutron counter	At neutron tube

DESCRIPTION	DATA
Hardware characteristics continued	
Data records, per scintillator Wireline and memory operations	Time decay: 128 channels Energy activated mode: 512 channels Energy passive mode: 512 channels
Combinability	Well monitoring and integrity services
Measurement	
Saturation	Oil, water, and gas
Porosity	0 to 60 porosity units
Spectral elemental yields	21 Elements fully characterized
TOC	From characterized total carbon yield
Passive spectral elemental yields	Potassium, uranium, thorium (KUTh)
Gravel pack evaluation	Si- and Al-based systems Gd traced systems
Water flow	Oxygen activation
Conveyance	
E-line	Full spectra via surface readout
Slickline and coiled tubing	Full spectra via memory
RELAY™ digital slickline system	QC data via surface readout and full spectra via memory

*HP/HT flask and extended HP tool housing are available for operations beyond specified limits. Contact your Halliburton representative for further details.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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